Effective Use Of Scatterometer Winds In Current and Future GMAO Reanalysis

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Poster number?

1. Introduction

- Scatterometers are sun-synchronous instruments which measure ocean-surface wind vector. A scatterometer determines surface roughness from a measured radar backscatter cross section. As surface roughness is a function of near-surface wind speed, near-surface wind vector can be determined by measuring the same point from multiple azimuth angles.
- Ocean-surface wind vector will play an important role in a coupled ocean-atmosphere assimilation system under development at the GMAO as they measure the ocean-atmosphere interface.
- GMAO's MERRA2 reanalysis system used ERS, QuikScat and ASCAT surface wind vectors. RapidScat data were not assimilated as the development of the system completed before the introduction of the instrument.
- Aim of this study is to evaluate the quality of RapidScat data and assess its benefits from the perspective of using it in a future NASA/GMAO reanalysis system.

2. RapidScat

- NASA's International Space Station (ISS)-RapidScat, was built of old spare parts and new hardware and was attached to the ISS as a platform to measure the winds on the ocean.
- ISS orbits at an inclination of 51.6° at a height ranging from 330 to 435 km in a non-sun-synchronous orbit with 12.5 km nominal footprint.
- Periodic orbit boost and station altitude maneuvers changed the instrument viewing geometry.

3. RapidScat in Near Real Time Processing

- RapidScat was assimilated in near real time system at the GMAO.
- There was a marked reduction in RMSE from the 21st of October when observation error and gross checked magnitude were changed, Figure-1.
- Background departure mean was almost unchanged, Figure-1.
- A degradation in the performance of RapidScat as a seen from March 2016 to August 2016, Figure-2. This degradation in FSOI corresponded to the degradation in observation quality as a function of time.

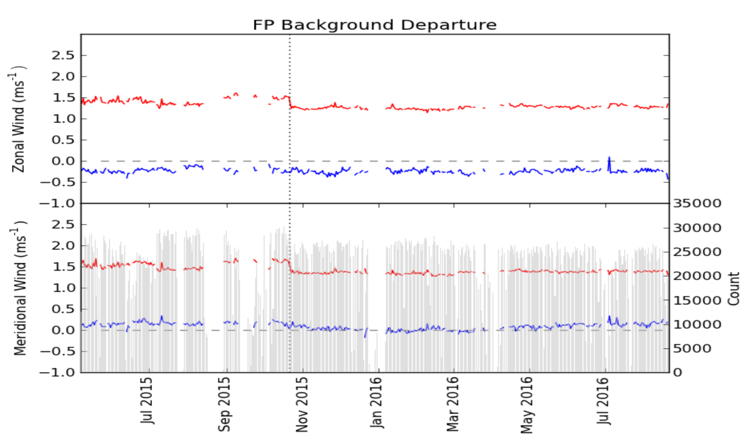

Figure-1 – The mean (blue) and RMS (red) of the background departure for assimilated observations for the zonal (top) and meridional (bottom) wind components from the GMAO Forward Processing system. Also shown are the assimilated observation counts (gray). The vertical dotted line represents 21 Oct 2015, which corresponds to the change of the specified observation error and gross check magnitude.

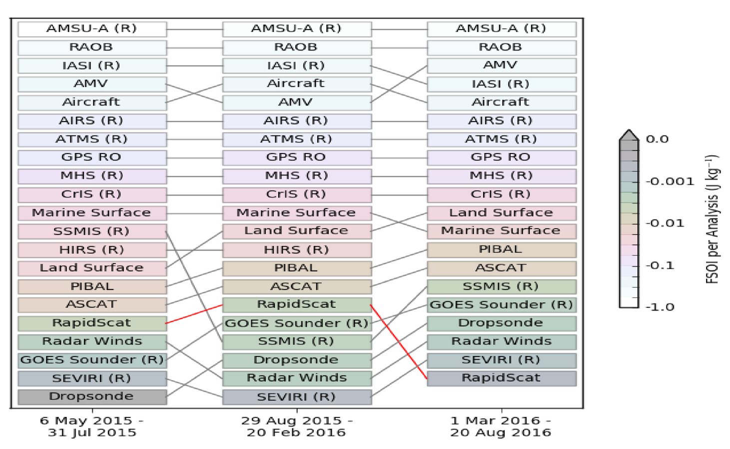

Figure-2 – Ranking of observation classes by the mean Forecast Sensitivity to Observation Impact (FSOI) per analysis for the given periods. The observation classes are shaded relative to their FSOI per analysis. Observation classes are connected from period to period by gray lines, with the exception of RapidScat, which is connected by red lines. Radiance observations are denoted by (R).

4. Passive Comparison of Four Versions of RapidScat with MERRA2

Version	V1.1	V1.2	V1.3	Clim_V1.0
Dates	3rd Oct 2014: 10th Mar 2016	19th Aug 2015: 20th Aug 2015	11th Feb 2016: 20th Aug 2016	3rd Oct 2014: 20th Aug 2016

- Versions (V1.1, V1.2 and V1.3) were created in response to changing signal-to-noise ratio of the instrument. Clim_V1.0 was a post-mission reprocessed data set that accounted for all the changes.
- RapidScat version Clim_V1.0 is the most stable and continuous among all versions of data. This version also shows least RMSE and mean background departure, Figure-3.

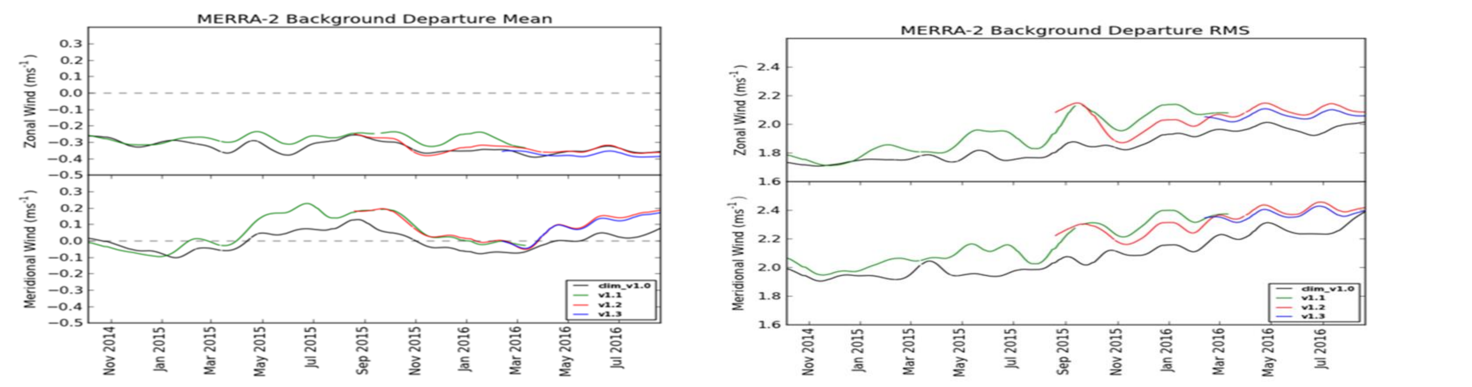

Figure-3. The daily background departure mean relative to MERRA-2 of the zonal (top) and meridional (bottom) winds for the v1.1 (green), v1.2 (red), v1.3 (blue), and clim_v1.0 (black) datasets. The values are smoothed using a 60 day Hann window

5. Comparison of RapidScat_ClimV1.0 with ASCAT

- RapidScat Version Clim_V1.0 is converted into BUFR from NetCDF format for the time period between 20141003 and 20160819
  - Data with quality flag > 0 are discarded
  - Pre-processing : Super-observation technique is applied (0.5°x0.5°)

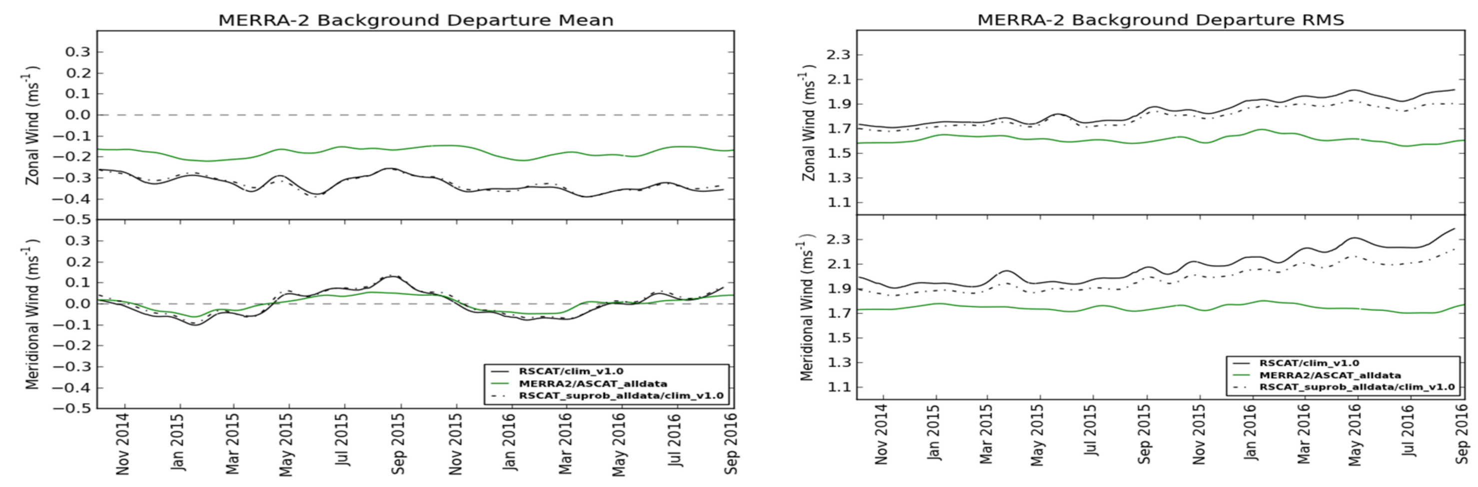

Figure-4. The daily background departure mean relative to MERRA-2 of the zonal (top) and meridional (bottom) winds for ASCAT (green), Rscat_Climv1.0 (black) and Rscat_Climv1.0_QC (black-dotted) datasets. The values are smoothed using a 60 day Hann window

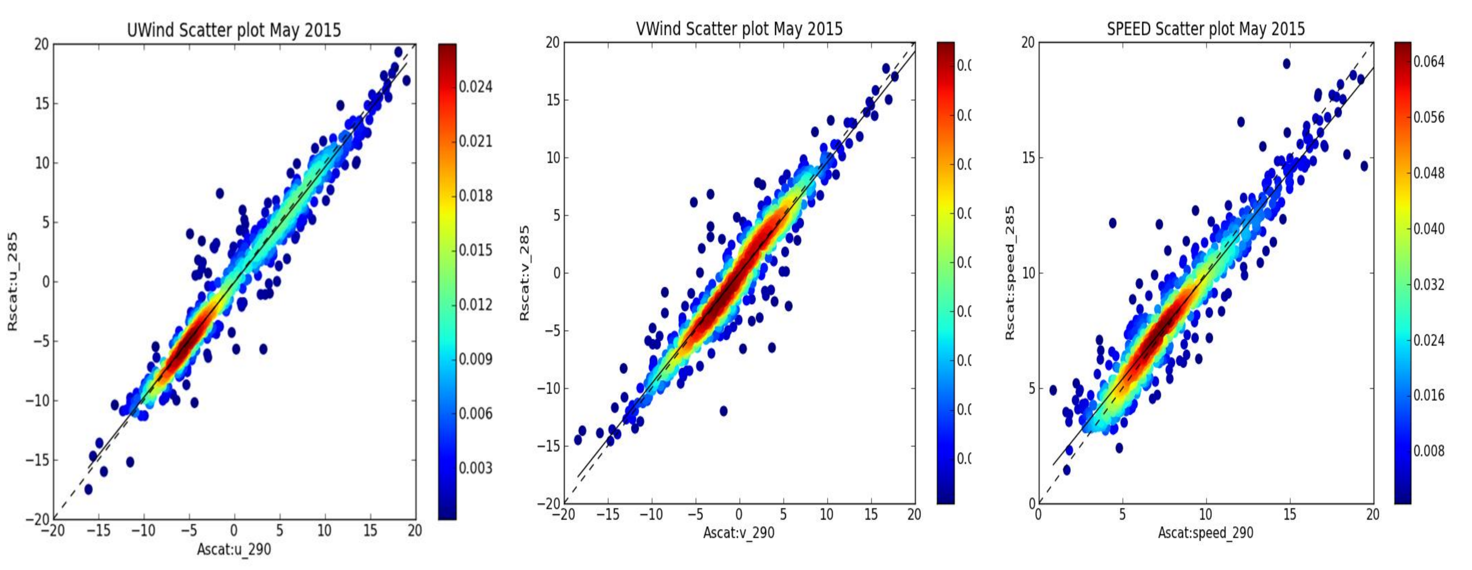

Figure-5. Scatter plots of ASCAT and RapidScat (left) Zonal, (center) Meridional and (right) Speed using Gaussian Kernel Density Function (KDE)

- Mean departure is similar for both raw and QC-ed RapidScat, Figure-4.
- RMS departure shows a reduction in RMS for QC-ed RapidScat, Figure-4.
- Scatter plot for collocated Ascat and Rapidscat shows more bias in Vwind than UWind, Figure-5.
- The bias is dependent on the wind speed as seen from the regression line, Figure-5.
- Bias in wind components and speed is dependent on magnitude.

6. Conclusion

- Initial assessment of RapidScat data shows that Clim_v1.0 version is the most stable dataset. The data also compares well with collocated ASCAT data although the bias between the two datasets have a dependence on the magnitude of wind speed.
- The preprocessing and superobbing methods for RapidScat were developed internally and were not consistent with other historical scatterometer datasets.
- A unified preprocessing methodology will improve consistency and allow easier integration of new datasets.

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